R E M A R K S

Careful review and examination of the subject application are noted and appreciated.

SUPPORT FOR THE CLAIM AMENDMENTS

Support for the claim amendments may be found in the specification, for example, on page 8 lines 6-21 and FIG. 1, as originally filed. Thus, no new matter has been added and no new issues are believed to be raised. Since the amendments should only require a cursory review and place the claims in better condition for appeal, entry of the amendments is respectfully requested.

CLAIM REJECTIONS UNDER 35 U.S.C. §102

The rejection of claims 1-18 under 35 U.S.C. §102(e) as being anticipated by Jeon (2004/0066848) is respectfully traversed and should be withdrawn.

Jeon concerns a direct mode motion vector calculation method for B picture (Title). In contrast, claim 1 of the present invention provides a method for determining a first and a second reference picture used for inter-prediction of a macroblock. The method generally includes steps (A) to (D). Step (A) may find a co-located picture and block. Step (B) may determine a reference index for the current block. Step (C) generally maps the reference index to a lowest valued reference index in a current reference

list. Step (D) may use the reference index to determine the second reference picture. The first and the second reference pictures may be used for inter-prediction of the current block. However, Jeon does not include all of the claimed limitations **as arranged in the claims** for the reasons given below.

Claims 1 and 10 are independently patentable over the cited reference. Claim 1 provides (B) determining a reference index for the current block and (C) mapping the reference index to a lowest valued reference index in a current reference list. The Office Action asserts that lines 9-12 in paragraph 0088 and all of paragraph 0089 of Jeon mention the claimed step (B) and paragraph 0090 of Jeon mentions the claimed step (C). In contrast, the cited text, and the rest of Jeon are silent regarding two steps in which a reference index is determined and then mapped to a lowest value. Therefore, Jeon does not include all of the claimed limitations as arranged in the claims.

In particular, the cited text of Jeon reads:

> [0088] ... Therefore, the present invention predicts and calculates list 0 and list 1 reference pictures and motion vectors from neighboring blocks of a macroblock of a B picture to be coded, on the basis of a spatial redundancy.
>
> [0089] A reference picture index for each list mode **is acquired in the following manner**. FIG. 5 is a view illustrating the motion vector prediction of a block E using motion vectors of neighboring blocks A, B and C in consideration of a general spatial redundancy.
>
> [0090] if the neighboring blocks A, B and C have different reference picture indexes, a smallest one of the reference

picture indexes is determined to be a reference picture index for the direct mode. (Emphasis added)

Based on the cited text, the Office Action appears to assert that (i) the B-picture block E of Jeon is similar to the claimed current block, (ii) the reference picture indexes of one of the neighboring blocks A, B or C is similar to the claimed reference index and (iii) the smallest one of the reference picture indexes is similar to the claimed lowest values reference index of the current reference list. However, Jeon is silent that a reference picture index is determined for the B-picture block E in one step and mapped to a different reference picture index in another step. Instead, cited text of Jeon clearly indicates that the reference picture index of the B-picture block E is acquired in a single step where the "smallest one of the reference picture indexes **is determined to be** a reference picture index for the direct mode" (emphasis added). The claim provides two steps, whereas Jeon only mentions a single step. The claim maps the reference index of the current block to a lowest valued reference index, whereas Jeon searches for the lowest value among the neighboring blocks. Jeon does not mention a transition of the reference picture index of B-picture block E between two values, specifically between the determined value and the mapped lowest valued. Therefore, Jeon does not include all of the claimed limitations **as arranged in the claims**.

Furthermore, page 2 of the Office Action asserts, "Step C as read by the examiner reads as finding the smallest reference index value in association to the current list, which Jeon teaches that the smallest value is used for the direct mode process which is applied to the current block." In contrast, Jeon does not appear to teach as the Office Action suggests. In particular, paragraph 0090 of Jeon appears to indicate that the smallest reference picture index among the neighboring blocks A, B and C is used for the B-picture block E. Jeon is silent that the smallest value "in association to the current list" is sought or even used for the B-picture block E because the smallest value of any reference picture index would always be zero. Thus, comparing the reference picture indexes of the three neighboring blocks A, B and C of Jeon would be meaningless if the answer is always the smallest reference picture index associated with the current reference list, as asserted in the rejection. Therefore, Jeon does not appear to disclose using the smallest reference picture index for the B-picture block E per the claim interpretation provided in the rejection. As such, Jeon does not include all of the claimed limitations as arranged in the claims.

Claim 1 further provides (A) finding a co-located picture and block and (D) using the reference index to determine the second reference picture, the first and the second reference pictures being used for inter-prediction of the current block. Claim 10

provides similar language. The Office Action asserts that (i) paragraph 0088 of Jeon mentions a picture and block similar to the claimed co-located picture and block and (ii) paragraph 0111 of Jeon mentions using a reference picture index of another block to determine a second reference picture. However, Jeon appears to be silent and the Office Action does not provide any evidence that the other block in paragraph 0111 of Jeon is the same B-picture block E in paragraph 0088 of Jeon. In contrast, one of ordinary skill in the art would appear to consider the other block in paragraph 0111 to be different than the B-picture block E in paragraph 0088 of Jeon. Therefore, Jeon does not include all of the claimed limitations **as arranged in the claims.**

In particular, the B-picture block E from paragraph 0088, which the Office Action considers to be similar to the claimed current block, is found in Case 1 of Jeon. The Case 1 B-picture block E of Jeon has a co-located block that is an intra block per the title of Case 1 and FIGS. 3f and 4f. The Case 1 co-located intra block has no motion information per paragraph 0088 of Jeon. In contrast, the other B-picture block mentioned in paragraph 0111 of Jeon is found in Case 3. The Case 3 B-picture block of Jeon has a co-located block with motion information per FIGS. 8a, 8b and 8c of Jeon. Since the Case 3 B-picture block does not have the same co-located block as the Case 1 B-picture block E, one of ordinary skill in the art would consider the Case 3 B-picture block to be a

different block than the Case 1 B-picture block E. As such, the rejection cite to paragraph 0111 of Jeon is inappropriate since the rejection mixes and matches two different B-picture blocks of Jeon in an attempt to satisfy the claimed limitations of the claimed current block. If the Case 1 B-picture block E of Jeon is similar to the claimed current block as asserted in the arguments for claim step (A), (B) and (C), the Case 1 B-picture block E has not been shown to satisfy the claimed step (D). If the Case 3 B-picture block of Jeon is similar to the claimed current block as asserted in the arguments for claim step (D), the Case 3 B-picture block has not been shown to satisfy all of the claimed steps (A), (B) and (C). Furthermore, it is impermissible to use the claims as a template to pick and choose unrelated sections of the reference to assemble the rejections. The arrangement of the claimed limitations must be expressly or inherently disclosed by the reference for a proper 102 rejection. Therefore, Jeon does not include all of the claimed limitations **as arranged in the claims.** As such, the Office is respectfully requested to either (i) clearly identify which one of the Case 1 B-picture block E or the Case 3 B-picture block of Jeon is allegedly similar to the claimed current block and present evidence that the identified B-picture block of Jeon discloses all of the claimed limitations as arranged in the claims or (ii) withdraw the rejections.

Claims 3 and 12 are independently patentable over the cited reference. Claim 3 provides storing a unique identifier for each reference picture, the unique identifier being associated from (i) when the unique identifier was used as an inter-reference in the co-located picture to (ii) when the unique identifier is made available as a potential List0 inter-reference for the current picture. Claim 12 provides similar language. The Office Action asserts that (i) lines 1-4 in paragraph 0005 of Jeon mention that a reference picture is stored in a buffer and (ii) a reference index identifies the reference picture. In contrast, one of ordinary skill in the art would understand that each of the reference indexes points to a position in a reference list, and since many reference pictures may occupy the pointed-to position at various time, the reference indexes are not uniquely identified with the reference pictures. Therefore, Jeon does not disclose all of the claimed limitations as arranged in the claims.

In particular, Thomas Wiegand et al., "Overview of the H.264/AVC Video Coding Standard" IEEE Transactions On Circuits and Systems For Video Technology, July 2003 (see Attachment A) state on page 12:

> B slices utilize two distinct lists of reference pictures, which are referred to as the first (list 0) and second (list 1) reference picture lists, respectively. **Which pictures are actually located in each reference picture list is an issue of the multi-picture buffer control** and an operation very similar to the conventional MPEG-2 B pictures can be enabled if desired by the encoder. (Emphasis added)

Note that Professor Wiegand was a co-chair of the Joint Video Team that developed the H.264/AVC specification (see Attachment B). Per Wiegand et al., the mix of reference pictures held in a reference list is dynamic. As such, a reference index to a particular position in a reference list (e.g., reference index=0) does not establish which of the many possible reference pictures is stored in the reference list. Thus, the assertion in the Office Action that the reference indexes uniquely identify reference pictures is in error and cannot be sustained. The cited text, and the rest of Jeon appear to be silent regarding a unique identifier for each of the reference pictures. Therefore, Jeon does not include all of the claimed limitations as arranged in the claims.

Furthermore, per the arguments from claim 1, the Office Action asserts that the claimed co-located block is similar to the Case 1 co-located intra block of Jeon. However, paragraph 0088 of Jeon states that the Case 1 co-located intra block "has no motion information." Since the Case 1 co-located intra block lacks motion information, the Case 1 co-located intra block does not involve an inter-reference prediction. Jeon appears to be silent that any reference pictures allegedly associated with the missing unique identifier is used as an inter-reference for the co-located intra block. Therefore, Jeon does not include all of the claimed limitations as arranged in the claims.

Furthermore, since Jeon does not mention any reference pictures allegedly associated with the missing unique identifier, Jeon is silent that the missing unique identifier is made available as a potential List0 inter-reference for the Case 1 B-picture block. Therefore, Jeon does not include all of the claimed limitations as arranged in the claims. As such, claims 3 and 12 are fully patentable over the cited reference and the rejections should be withdrawn.

Claims 4 and 13 are independently patentable over the cited reference. Claim 4 provides storing a unique identifier of a direct-mode reference picture. Claim 13 provides similar language. The Office Action asserts that (i) lines 1-2 in paragraph 0005 of Jeon mention that a reference picture is stored in a buffer and (ii) a reference index identifies the reference picture. In contrast, the claim is to store the unique identifier, not the reference picture. Furthermore, as shown above in the arguments for claims 3 and 12, one of ordinary skill in the art would appear to understand that the reference indexes point to positions in the reference lists, not to individual reference pictures. Therefore, Jeon does not include all of the claimed limitations as arranged in the claims.

In particular, the cited text of Jeon reads:

> [0005] On the other hand, a B picture proposed in a next-generation moving picture compression technique such as H.264 or MPEG-4 part 10 is characterized in that the B

> picture is allowed to be used as a reference picture because it can be stored in a reference picture buffer.

Nowhere in the above text, of in any other section does Jeon appear to mention a unique identifier of the B picture. The cited text merely mentions that H.264 and MPEG-4 permit B pictures to be used as reference pictures. Nothing is said about storing unique identifiers for the reference B pictures. Therefore, Jeon does not include all of the claimed limitations as arranged in the claims. As such, claims 4 and 13 are fully patentable over the cited reference and the rejections should be withdrawn.

Claims 5 and 14 are independently patentable over the cited reference. Claim 5 provides that the direct-mode operates on (i) a macroblock when in a first configuration and (ii) a macroblock partition when in a second configuration. The Office Action assets that paragraph 0087 of Jeon mentions (i) macroblocks when in a first configuration and (ii) macroblock partitions when in a second configuration. In contrast, the cited text and the rest of Jeon appear to be silent regarding (i) a first configuration and a second configuration and (ii) how the system of Jeon operates differently when in the two configurations. Therefore, Jeon does not include all of the claimed limitations as arranged in the claims.

In particular, the cited text of Jeon reads:

> [0087] On the other hand, a frame mode and a field mode are switched at a picture level, so the B picture and list 1 reference picture can be coded into frame mode or field mode.

> As a result, a macroblock of the B picture and a co-located macroblock of the list 1 reference picture have four types of frame/field-coded combinations.

Nowhere in the above text, or in any other section does Jeon appear to mention two configurations similar to the claimed first configuration and the claimed second configuration. Instead, the cited text merely mentions that a B picture and a co-located macroblock can have four types of frame/field-coded combinations. Furthermore, nowhere in the above text does Jeon appear to mention macroblock partitions, as presently claimed. Therefore, Jeon does not include all of the claimed limitations as arranged in the claims. As such, claims 5 and 14 are fully patentable over the cited reference and the rejection should be withdrawn.

Claims 6 and 15 are independently patentable over the cited reference. Claim 6 provides searching the current reference list (for the current block) for the lowest valued reference index identified by the unique identifier and returning the value of the lowest valued reference index. Claim 15 provides similar language. The Office Action asserts that paragraph 0090 of Jeon mentions searching a list 0 reference list for a reference index identified by a unique identifier. In contrast, as argued above for claims 3 and 12, Jeon is silent regarding unique identifiers for the reference pictures. Thus, Jeon cannot mention searching for a reference index identified by the missing unique identifiers.

Therefore, Jeon does not include all of the claimed limitations as arranged in the claims.

In particular, the cited text of Jeon reads:

> [0090] if the neighboring blocks A, B and C have different reference picture indexes, a smallest one of the reference picture indexes is determined to be a reference picture index for the direct mode.

Nowhere in the above text, or in any other section does Jeon mention searching the reference picture list of the Case 1 B-picture block E. Instead, the above text appears to mention finding a smallest reference picture index of the neighboring blocks A, B and C. Jeon is comparing the reference picture indexes of the neighboring blocks A, B and C, not searching the reference index list of the Case 1 B-picture block E. The above text does not even mention searching the reference picture lists of the neighboring blocks A, B and C. Therefore, Jeon does not include all of the claimed limitations as arranged in the claims. As such, claims 6 and 15 are fully patentable over the cited reference and the rejections should be withdrawn.

Claims 2-9 and 11-18 depend, either directly or indirectly, from the independent claims, which are now believed to be allowable. As such, the dependent claims are fully patentable over the cited reference and the rejections should be withdrawn.

Accordingly, the present application is in condition for allowance. Early and favorable action by the Examiner is respectfully solicited.

The Examiner is respectfully invited to call the Applicants' representative between the hours of 9 a.m. and 5 p.m. ET at 586-498-0670 should it be deemed beneficial to further advance prosecution of the application.

If any additional fees are due, please charge Deposit Account No. 12-2252.

Respectfully submitted,

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John J. Ignatowski
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Dated: October 26, 2009

c/o Pete Scott
LSI Corporation

Docket No.: 03-1431 / 1496.00341

Attachment A 1of2
10/785,273

Overview of the H.264 / AVC Video Coding Standard

Thomas Wiegand, Gary J. Sullivan, Gisle Bjontegaard, and Ajay Luthra

Abstract— **H.264/AVC is newest video coding standard of the ITU-T Video Coding Experts Group (VCEG) and the ISO/IEC Moving Picture Experts Group (MPEG). The main goals of the H.264/AVC standardization effort have been enhanced compression performance and provision of a "network-friendly" video representation addressing "conversational" (video telephony) and "non-conversational" (storage, broadcast, or streaming) applications. H.264/AVC has achieved a significant improvement in rate-distortion efficiency relative to existing standards. This article provides an overview of the technical features of H.264/AVC, describes profiles and applications for the standard, and outlines the history of the standardization process.**

Index Terms—**Video, Standards, MPEG-2, H.263, MPEG-4, AVC, H.264, JVT.**

I. Introduction

H.264/AVC is the newest international video coding standard [1]. By the time of this publication, it is expected to have been approved by ITU-T as Recommendation H.264 and by ISO/IEC as International Standard 14496-10 (MPEG-4 part 10) Advanced Video Coding (AVC).

The MPEG-2 video coding standard (also known as ITU-T H.262) [2], which was developed about 10 years ago primarily as an extension of prior MPEG-1 video capability with support of interlaced video coding, was an enabling technology for digital television systems worldwide. It is widely used for the transmission of standard definition (SD) and High Definition (HD) TV signals over satellite, cable, and terrestrial emission and the storage of high-quality SD video signals onto DVDs.

However, an increasing number of services and growing popularity of high definition TV are creating greater needs for higher coding efficiency. Moreover, other transmission media such as Cable Modem, xDSL or UMTS offer much lower data rates than broadcast channels, and enhanced coding efficiency can enable the transmission of more video channels or higher quality video representations within existing digital transmission capacities.

Video coding for telecommunication applications has evolved through the development of the ITU-T H.261, H.262 (MPEG-2), and H.263 video coding standards (and later enhancements of H.263 known as H.263+ and H.263++), and has diversified from ISDN and T1/E1 service to embrace PSTN, mobile wireless networks, and LAN/Internet network delivery. Throughout this evolution, continued efforts have been made to maximize coding efficiency while dealing with the diversification of network types and their characteristic formatting and loss/error robustness requirements.

Recently the MPEG-4 Visual (MPEG-4 part 2) standard [5] has also begun to emerge in use in some application domains of the prior coding standards. It has provided video shape coding capability, and has similarly worked toward broadening the range of environments for digital video use.

In early 1998 the *Video Coding Experts Group* (VCEG – ITU-T SG16 Q.6) issued a call for proposals on a project called H.26L, with the target to double the coding efficiency (which means halving the bit rate necessary for a given level of fidelity) in comparison to any other existing video coding standards for a broad variety of applications. The first draft design for that new standard was adopted in October of 1999. In December of 2001, VCEG and the *Moving Picture Experts Group* (MPEG – ISO/IEC JTC 1/SC 29/WG 11) formed a *Joint Video Team (JVT)*, with the charter to finalize the draft new video coding standard for formal approval submission as H.264/AVC [1] in March 2003.

The scope of the standardization is illustrated in Fig. 1, which shows the typical video coding/decoding chain (excluding the transport or storage of the video signal). As has been the case for all ITU-T and ISO/IEC video coding standards, only the central decoder is standardized, by imposing restrictions on the bitstream and syntax, and defining the decoding process of the syntax elements such that every decoder conforming to the standard will produce similar output when given an encoded bitstream that conforms to the constraints of the standard. This limitation of the scope of the standard permits maximal freedom to optimize implementations in a manner appropriate to specific applications (balancing compression quality, implementation cost, time to market, etc.). However, it provides no guarantees of end-to-end reproduction quality, as it allows even crude encoding techniques to be considered conforming.

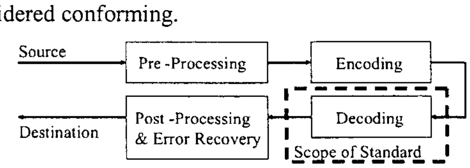

Fig. 1: Scope of video coding standardization.

Attachment A 2 of 2
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motion-compensated 16x16, 16x8, 8x16, or 8x8 luma block. Motion compensation for smaller regions than 8x8 use the same reference index for prediction of all blocks within the 8x8 region.

In addition to the motion-compensated macroblock modes described above, a P macroblock can also be coded in the so-called P_Skip type. For this coding type, neither a quantized prediction error signal, nor a motion vector or reference index parameter is transmitted. The reconstructed signal is obtained similar to the prediction signal of a P_16x16 macroblock type that references the picture which is located at index 0 in the multi-picture buffer. The motion vector used for reconstructing the P_Skip macroblock is similar to the motion vector predictor for the 16x16 block. The useful effect of this definition of the P_Skip coding type is that large areas with no change or constant motion like slow panning can be represented with very few bits.

2) Inter-frame Prediction in B Slices

In comparison to prior video coding standards, the concept of B slices is generalized in H.264/AVC. This extension refers back to [11] and is further investigated in [12]. For example, other pictures can reference pictures containing B slices for motion-compensated prediction, depending on the memory management control operation of the multi-picture buffering. Thus, the substantial difference between B and P slices is that B slices are coded in a manner in which some macroblocks or blocks may use a weighted average of two distinct motion-compensated prediction values for building the prediction signal. B slices utilize two distinct lists of reference pictures, which are referred to as the first (list 0) and second (list 1) reference picture lists, respectively. Which pictures are actually located in each reference picture list is an issue of the multi-picture buffer control and an operation very similar to the conventional MPEG-2 B pictures can be enabled if desired by the encoder.

In B slices, four different types of inter-picture prediction are supported: list 0, list 1, bi-predictive, and direct prediction. For the bi-predictive mode, the prediction signal is formed by a weighted average of motion-compensated list 0 and list 1 prediction signals. The direct prediction mode is inferred from previously transmitted syntax elements and can be either list 0 or list 1 prediction or bi-predictive.

B slices utilize a similar macroblock partitioning as P slices. Beside the P_16x16, P_16x8, P_8x16, P_8x8, and the intra coding types, bi-predictive prediction and another type of prediction called direct prediction, are provided. For each 16x16, 16x8, 8x16, and 8x8 partition, the prediction method (list 0, list 1, bi-predictive) can be chosen separately. An 8x8 partition of a B macroblock can also be coded in direct mode. If no prediction error signal is transmitted for a direct macroblock mode, it is also referred to as B_Skip mode and can be coded very efficiently similar to the P_Skip mode in P slices. The motion vector coding is similar to that of P slices with the appropriate modifications because neighbouring blocks may be coded using different prediction modes.

I. Transform, Scaling, and Quantization

Similar to previous video coding standards, H.264/AVC utilizes transform coding of the prediction residual. However, in H.264/AVC, the transformation is applied to 4x4 blocks, and instead of a 4x4 discrete cosine transform (DCT), a separable integer transform with similar properties as a 4x4 DCT is used. The transform matrix is given as

$$H = \begin{bmatrix} 1 & 1 & 1 & 1 \\ 2 & 1 & -1 & -2 \\ 1 & -1 & -1 & 1 \\ 1 & -2 & 2 & -1 \end{bmatrix}$$

Since the inverse transform is defined by exact integer operations, inverse-transform mismatches are avoided. The basic transform coding process is very similar to that of previous standards. At the encoder the process includes a forward transform, zig-zag scanning, scaling and rounding as the quantization process followed by entropy coding. At the decoder, the inverse of the encoding process is performed except for the rounding. More details on the specific aspects of the transform in H.264/AVC can be found in [17].

It has already been mentioned that Intra_16x16 prediction modes and chroma intra modes are intended for coding of smooth areas. For that reason the DC coefficients undergo a second transform with the result that we have transform coefficients covering the whole macroblock. An additional 2x2 transform is also applied to the DC coefficients of the four 4x4 blocks of each chroma component. The procedure for a chroma block is illustrated in Fig. 15. The small blocks inside the larger blocks represent DC coefficients of each of the four 4x4 chroma blocks of a chroma component of a macroblock numbered as 0,1,2, and 3. The two indices correspond to the indices of the 2x2 inverse Hadamard transform.

To explain the idea behind these repeated transforms, let us point to a general property of a two-dimensional transform of very smooth content (where sample correlation approaches 1). In that situation the reconstruction accuracy is proportional to the inverse of the one dimensional size of the transform. Hence, for a very smooth area, the reconstruction error with a transform covering the complete 8x8 block is halved compared to using only 4x4 transform. A similar rationale can be used for the second transform connected to the INTRA-16x16 mode.

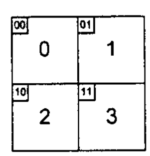

Fig. 15: Repeated transform for chroma blocks. The four blocks numbered 0 to 3 indicate the four chroma blocks of a chroma component of a macroblock.

There are several reasons for using a smaller size transform:

Attachment B
10/785,273

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He received the Dipl.-Ing. degree in Electrical Engineering from the Technical University of Hamburg-Harburg, Germany, in 1995 and the Dr.- Ing. degree from the University of Erlangen-Nuremberg, Germany, in 2000. He joined the Heinrich Hertz Institute in 2000 as the head of the Image Communication group in the Image Processing department and remains also active in this role. His research interests include video processing and coding, multimedia transmission, semantic image representation, as well as computer vision and graphics.

From 1993 to 1994, he was a Visiting Researcher at Kobe University, Japan. In 1995, he was a Visiting Scholar at the University of California at Santa Barbara, USA. From 1997 to 1998, he was a Visiting Researcher at Stanford University, USA and served as a consultant to 8x8, Inc., Santa Clara, CA, USA. From 2006-2008, he was a consultant to Stream Processors, Inc., Sunnyvale, CA, USA. From 2007-2009, he was
a consultant to Skyfire, Inc., Mountain View, CA, USA. Since 2005, he is a member of the technical advisory boards of Vidyo, Inc., Hackensack, NJ, USA.

Since 1995, he is an active participant in standardization for multimedia with successful submissions to ITU-T VCEG, ISO/IEC MPEG, 3GPP, DVB, and IETF. In October 2000, he was appointed as the Associated Rapporteur of ITU-T VCEG. In December 2001, he was appointed as the Associated Rapporteur / Co-Chair of the JVT. In February 2002, he was appointed as the Editor of the H.264/AVC video coding standard and its extensions (FRExt and SVC). From 2005-2009, he was Co-Chair of MPEG Video.

In 1998, he received the SPIE VCIP Best Student Paper Award. In 2004, he received the Fraunhofer Award for outstanding scientific achievements in solving application related problems and the ITG Award of the German Society for Information Technology. In 2009, he received the Innovations Award of the Vodafone Foundation, the EURASIP Group Technical Achievement Award, and the Best Paper Award of IEEE Transactions on Circuits and Systems for Video Technology.

Since January 2006, he is an Associate Editor of IEEE Transactions on Circuits and Systems for Video Technology.